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HOW TO MANUFACTURE CONCRETE HOLLOW BLOCKS.

A Textbook for All Those Who Manufacture Hollow Blocks or Use Concrete in Any Form.

BY PAUL WILKES,

ARCHITECT AND CIVIL ENGINEER.

PRICE 50 CENTS

CLEVELAND, OHIO, 24 WICK BLOCK.

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Introduction

Owing to the rapid development of the Cement Industry, the question of manufacture has become of importance. Of late, a number of persons who have had no practical experience whatever have been flooding the public with articles and pamphlets setting forth their impractical views and theories, which are likely to do great damage to those who follow them. To use our present methods of building as applicable to Cement-work requires practical experience combined with proper theories. It also requires a harmonious architectural plan. The object of this Leaflet is to bring in a concise but practical form the experience of the author to its readers and to prevent this new industry from being dragged into the mire at its beginning.

I am confident that every one who uses Cement in any form will find something useful and beneficial in these pages.

To the manufacturer of Hollow-block stone as well as to the Cement manufacturer this leaflet will furnish practical instruction based upon years of experience in that line of work.

I would also suggest that the perusal of the Monthly Journal, "The Artificial Stone and Concrete Builder," $1.00 per year, would be of great benefit to all. This Journal brings views of all possible stones and their manufacture, also plans for large or small dwellings and buildings of all kinds; in fact, brings illustrations and descriptions of all kinds of Concrete Construction.

Cleveland, Ohio. PAUL WILKES.

How to Manufacture Concrete Hollow Blocks

This is a question which is being considered by thousands at the present time and will be considered by more in the future. There are two methods which produce good results, the dry-stamp process and pouring or wet process. Both methods have each their advantages and disadvantages. Of course, the manufacturer of machinery for either process will laud his system. I will endeavor without prejudice or favor to state what I have learned practically.

By the wet process, mix the concrete-mortar thick, without any surplus water on the surface, shake or stamp lightly until the form is filled, but the concrete must always be evenly moist, otherwise it will change color. Do not mix the concrete as thin as water, as is frequently done now, as it hardens too slowly and its adhesiveness is in many Cements diminished. The Cement is "drowned out," as it is called. In this manner a number of forms are filled, and remain standing from one to three days to bind, sometimes longer. The advantage over the dry process is this: that the stone is more compact and contain but few, if any, air chambers, and consequently are less influenced by the weather. The disadvantage consists in the fact that the manufacture of stone on a large scale requires many forms, and that frequently they are hard to remove.

The manufacturer is compelled in most cases to grease the forms so as to remove the molds easier, and it also frequently happens that the surfaces are not smooth, and the sides adhere.

Greasing or painting the forms with oil paint has the disadvantage that the grease or paint coming in contact with the calcium in the Cement produces chemically a soap which is worked in at the surface. This in time causes a change of color in the work. This fault arises also occasionally in the wet process, even if no grease is used. In most sand there are contained organic substances which through the longer process of binding have the influence of changing the color as the water dissolves them chemically. This latter occurs frequently where by washing off the Cement with a too strong stream of water.

In this manner we sometimes get a harder stone, sometimes as hard as granite, but it has, as shown, the disadvantage of changeable color, which neither the architect nor the public likes.

In this respect the dry process has the advantage. There have been placed on the market of late a large number of machines, and it is as yet impossible for any one to say which is the most practical and best. Each has advantages and disadvantages of its own.

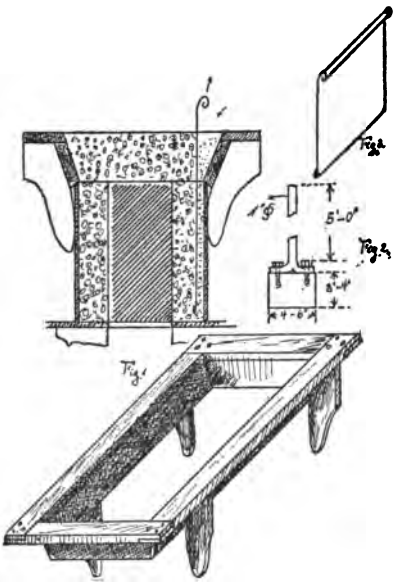
The most common method used until now is as follows. A better one is described hereafter: Mix the material about the consistency of moist earth; then add small layers and stamp in with hand-stamper, and smooth over. Then remove the stone from the form, and place on wood, iron or sand palets. By this process much time is saved against the wet process, but a "facing" with fine material can only be made with difficulty; but the latter is, however, absolutely neccessary to give the stone its natural appearance. The stone by receiving this fine mixture becomes stronger and more compact and resists the atmospheric influences better. In this manner the stone can be colored at a trifling expense, which was impossible heretofore. For

many readers and for the entire Cement Industry the following statements of practical discoveries will be of great value, and lead this industry into new channels.

It is well known that a stone made from rough material, or even made from fine material, does not have a fine appearance and is not a stone of first quality, neither is it waterproof. Experiments have been made with finer material and plenty of cement, and in this manner better stones have been produced, but at a greater expense and unnecessary material strength. For ordinary building purposes, a calculation proves that mixtures of good cement with 6-8 parts of sand after proper storage, gives already more than the required material strength. This stone must be "faced" with a fine mixture, and some manufacturers of Cement Stone who have seen this necessity have already invented flat laying "facing machines," which increase labor and expense. The upright machines, as I will show, have proven best and the most practical. Owing to the many difficulties we have to overcome in the construction of large buildings, we have found a system by which we can produce stone which the layman or novice cannot distinguish from the natural product. Like every other invention is simple, so this is; simpler than many imagine. *"Necessity"* here, like elsewhere, was the "mother of invention."

First, construct a wooden or iron frame like Fig. 1, so it can be easily taken off and set up again; it must be sufficiently high so as to take in all the material required for the stone at once. First hold a tin-plate, as shown in Fig. 3, in the form or mold at the required thickness of the facing material, then fill in the fine material in the crevices and then shovel the rough material in at once. In

using mixing machines you can use a funnel in which you can place the necessary quantity of material for the stone. After having put in your "facing" remove the tin-plate and stamp down the rough



material with a stamper, whose handle should be at least 5 feet long. The workman stands on the frame and in that position does the stamping, the long handle assisting him greatly.

The laborer soon becomes proficient in the use of the heavy stamper. He raises it swingingly to a certain height and lets it drop and the stamper does its own work, which is impossible if the laborer stands at the side of the mould. After having stamped the mixture with two or three stampings he leveled the sides and ends. It is always best to count the strokes used, as all stones will be stamped alike then.

The following may be used for stones up to 12 inches thick: First 3 stamps over the entire mixture of the stone, then smoothing

of the crevices, then 6-8 more stamps everywhere, then again smoothing, and again 6-8 stamps, and the stone is more solid than by any other process. After filling the crevices the laborer should make them rough so as all parts of the stone will adhere better. If you use a stamper 6 inches wide and you have a stone 32 inches long you have about 14 stamp surface to cover with an average of 18-20 stamps to each place gives you about 250-280 stampings you have to do on each stone. Some workmen do this in 3-4 minutes. In this manner stones 12 to 14 inches high can be made at once. The ends are made smooth with a trowel. Always have your stamper 1 inch smaller than your stone. A great advantage of this method is that your stone is completed at once, and is far superior to a stone where you fill in 4-6 times; it is even all through. Many times the workmen forget to scratch the smooth ends rough, which must be done so as to make all parts of the stone well adhered. These evils will disappear at once if the above described methods is followed. The advantage is readily seen and I have myself had great success with it. Those whom I have already instructed in this method have saved already, as they tell me, over 50% of material and cost to say nothing of turning out a flawless stone. In the future the upright machines will supersede the flat machines. Stones can also be made in natural cement color or colored as desired with very little expense. In regard to durability I may say that we have done work of this kind 15 years ago which does not show the least defacement to this day. In breaking a stone for tests it has shown that the connection between the fine and rough material was complete and cannot separate in the course of time.

Another advantage is that such stones are almost waterproof, and by the use of good cement and fine, pure sand as mixture can be made absolutely waterproof. Of course, this is not the case in the first year, but the water penetrability is slight even then, but after that time it is perfect.

If it is desirable to paint an entire cement building, never paint it the first year, as it will not hold until the cement has cured entirely. This requires at least a year. Brush the surface with water which contains 2% of copper-vetriolic acid, then give 2-4 coats of paint and this will last much longer than on any wood work. Only observe to put the paint on thin and that each coat is well dried before you put on the next. If too thick it will peel off.

According to my opinion, it is foolish to paint a sandstone with oil paint. I only sanction the method because it is frequently desired and is practical but looks not very good. To manufacture waterproof stone is the desire of all who make Concrete Stone, and two methods have been discussed by which this can be done with very little expense and labor.

The first and best method is, that instead of using water with the fine facing material, milk is used; if a little sour the better, as it will increase the impenetrability.

Another method is a patent wash which is put on with a brush and which crystallizes in the stone. There are several of these washes which answer the purpose more or less. To recommend to the beginner in this field a certain machine as the best is impossible even by the best expert. All have some advantages and also some disadvantages which about equalize themselves in use. A visit to these machines will corroborate my statement.

For a permanent fixture or plant a place close by a sand bank which can be protected against frost in winter is most suitable. In summer time any wooden shed will answer the purpose. Protect only against the sun and rain. Cost of transportation of material, raw or finished product, is also a factor in the erection of a plant. Many times the roof boards for the new building can be used for a temporary shed and frequently the sand or ground from the excavations will furnish necessary material. The idea is to save as much expense as possible.

As concrete—or cement—is a mixture of gravel and sand or broken stone in which cement is only the cement, glue or adhesive power, it attains to the hardness of mortar.

To ascertain the proper mixing proportions for concrete, determine the proportion of cement and sand.

The quantity of gravel or broken stone added to this mortar is to be measured. Fill all crevices with gravel or broken stone and fill in also a thin layer of mortar. To ascertain the size of hollow spaces or crevices, fill with water by the use of a quart measure. The water required indicates the amount of mortar required. Gravel with kernels of from ⅛ to 1½ inches diameter is the best, as it contains the least hollow spaces and in consequence requires the least mortar. In large work the proportion is frequently left to the judgment of the builder, but as stones vary it is best to take no chances but to make positive tests. To ascertain the proper mixture, mix sand and gravel in a quart measure and weigh; the heaviest mixture has the least hollow spaces and is the proper mixture to use. This very simple method should be used in all big work. By a little experimenting you will ascertain a difference of from

5 to 20%. For this reason, a rule without experiments is of little use. But to give a starting point the following tested formula can be used:

1 part cement, 2 parts sand, 4 parts gravel or 3 parts broken stone.
1 part cement, 3 parts sand, 6 parts gravel or 4.5 parts broken stone.
1 part cement, 4 parts sand, 8 parts gravel or 6 parts broken stone.
1 part cement, 5 parts sand, 10 parts gravel or 7.6 parts broken stone.
1 part cement, 6 parts sand, 12 parts gravel or 9 parts broken stone.

If a mixture of sand and gravel is convenient, ascertain the proportion of gravel by sieving a sample. Concrete which consists only of cement and rough gravel without sand reaches only about one-half of the tenacity as that which has sand added to it.

Material Required and Gain of Concrete.

Gravel with 35% of Hollow Space.

Cement Part	Sand Part	Gravel Part	Gain Part	Necessary for 1 Cubic Yard Concrete		
				Cement cub. ft.	Sand cub. ft.	Gravel cub. ft.
1	2	4	4.40	4.8	9.6	19.0
1	3	6	6.65	3.2	9.6	19.0
1	4	8	8.85	2.4	9.6	19.0
1	5	10	11.25	1.9	9.6	19.0
For Broken Stone with 47% Hollow Spaces						
1	2	3	3.55	6 0	12.8	19.0
1	3	4½	5.00	4.3	12.8	19.0
1	4	6	6.50	3.3	12.8	19.0
1	5	7½	8.35	2.5	12.8	19.0

For Sand With Gravel

Cement in Parts	Sand in Parts	Gain in Per Cent.	Required for cub. yd. Stamped Cement	Concrete Sand
1	0.0	90.00	30.00	00.00
1	1.0	73.50	18.20	18.20
1	2.0	68.00	13.10	26.50
1	2.5	70.50	11.00	28.50
1	3.0	72.75	9.30	28.60
1	3.5	74.50	8.20	28.60
1	4.0	76.40	7.40	28.60
1	4.5	77.40	6.30	28.70
1	5.0	78.84	5.70	28.70
1	5.5	79.60	4.10	28.70
1	6.0	80.51	4.80	28.70
1	6.5	81.30	4.40	28.70
1	7.0	81.88	4.20	28.80
1	9.0	82.84	3.70	28.80
1	8.0	83.70	2.80	28.90
1	10.0	84.37	2.70	28.90
1	11.0	84.92	2.50	30.00
1	12.0	85.59	2.40	30.00

Weights and Measures.

A cubic foot of gravel weighs 160–170 lbs.

A cubic foot of Portland Cement weighs 80–100 lbs.

A cubic foot of Rosendale Cement weighs 56–60 lbs.

A cubic foot of stamped concrete weighs 140 lbs.

A cubic foot of loose concrete weighs 100–120 lbs.

A cubic foot of earth, dry and loose, weighs 90–100 lbs.

A cubic foot of quarz sand weighs 165 lbs.

Square Measure.	Cubic Measure.
144 sq. inches equal 1 sq. foot	1728 cub. in. equal 1 cub. ft.
9 sq. feet equal 1 square yard	27 cubic feet equal 1 cub. yd.
30¼ sq. yds. equal 1 square rod	24¾ cub. yds. equal 1 perch

Dry Measure.

2 pints equal 1 quart

8 quarts equal 1 peck

4 pecks equal 1 bushel

1 cubic foot equals 1.25 bushels

As mixture for *facing material* take where it is to be used quickly or needs great tenacity a mixture of 2 parts of sand and 1 part cement, but in general better 3:1 parts, which will also prevent air cracks.

The rough mixture depends, as already stated, upon the material used as well as upon the work it is to perform. It also depends upon the cement itself. Best make a stone of such different mixtures and with a little practice one can easily ascertain the proper proportion.

An addition of lime in the proportion as used in waterproof mortar is in general not to be recommended for fine art stone work and is always dangerous on account of its showing through and swelling. Avoid also all porcelain and slag cements, for they contain chemical properties, especially sulphur, which while not injurious at first, in a short time destroys the work. The same is true of a mixture of gypsum and many other highly advertised mixtures. Use for art stones only the best quality of Portland Cement. All other cements are not suitable for that purpose, but may be used for concrete foundations, etc.

For the use of small quantities up to 15 cubic yards, mixing machines are not necessary. A laborer can easily mix 8-10 cubic yards in a day. Measure sand and cement with an exact measure, the best is a wooden box. Spread your sand evenly and then add the measured cement, then mix the whole mass by shoveling it three times in the form of a cone so that it gets thoroughly mixed; then add the water while continually mixing. Remember to mix three times dry and twice wet; even this depends upon the moisture of the sand. After the stone is formed, keep it moist so that the edges do not fade. This must be watched for 2-3 weeks according to the weather; also protect during this time the stone from the heat of the sun, sharp winds or frost. Do not give the stones too much water. It is said by some, "The more water the better." I have found by experience that this is not the case, although it is true that cement entirely under water usually gets harder than that drying in the air. The best results are obtained, as already stated, by using just sufficient water to keep the stone from drying out. If it is desirable to make a construction of cement stone or brick waterproof, use the following described mortar.

The impenetrability of waterproof cement becomes stronger in proportion to the thickness of the cement used.

For cement plaster of ½-1 inch thick which should be waterproof the following mortar mixture can be recommended:

1 part cement, 1 part sand, not too coarse.

1 part cement, 2 parts sand, ½ part slack lime.

1 part cement, 3 parts sand, 1 part slack lime.

1 part cement, 5 parts sand, 1½ part slack lime.

1 part cement, 6 parts sand, 2 part slack lime.

Which of these mixtures is best to use, depends principally upon the strength required. If the mortar is not required immediately one part of sand more can be added, as Portland Cement gains in adhesiveness by the addition of water. In this case you can also use a ½ part lime less. By using the above mixtures we obtain waterproof concrete. Usually concrete is not made waterproof only just so that it answers the required tenacity, and it is then covered with the above waterproof coating. In using slacked lime, the lime should be slacked at least 2 months in advance before using, whereas otherwise, through swelling, it will expand and particles spring off. This lime cement is convenient for water basins. To prevent hair or wind crevices see to it that the cement does not lose its water by sudden evaporation. To figure the cost of work is easy especially if you number your artificial stone and know exactly at all times what material you required. *The Artificial Stone and Concrete Builder* brings each month details of special work with illustrations and descriptions, and thus aids the manufacturer and builder without his going into costly experiments, which the pioneers of this industry had to do.

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